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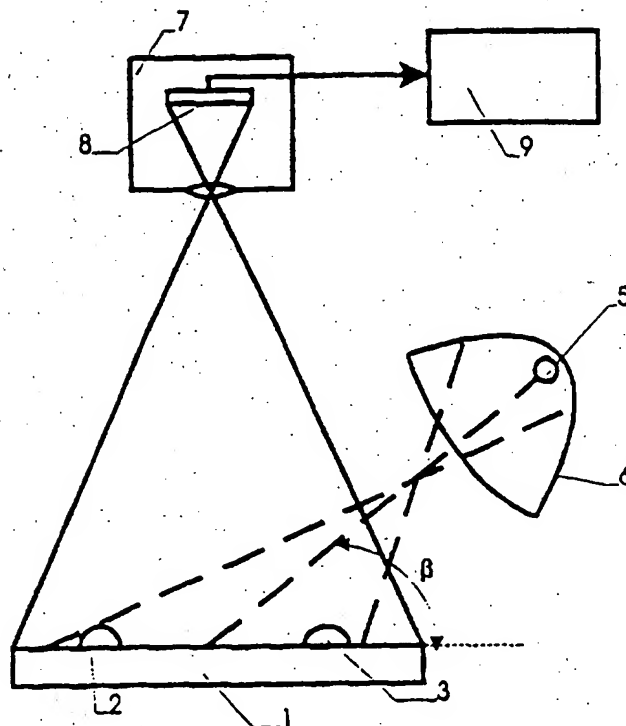
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup>:</b>  <b>G01N 21/89</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 96/34273</b>  <b>(43) International Publication Date:</b> 31 October 1996 (31.10.96)
<b>(21) International Application Number:</b> PCT/SE96/00534  <b>(22) International Filing Date:</b> 23 April 1996 (23.04.96)  <b>(30) Priority Data:</b> 9501559-0 27 April 1995 (27.04.95) SE  <b>(71) Applicant:</b> INDUSTRIAL VISION SYSTEMS AB [SE/SE]; Datorgatan 5, S-561 33 Huskvarna (SE).  <b>(72) Inventors:</b> ERIKSSON, Gösta; Gullvingevägen 13, S-561 48 Huskvarna (SE). RINNFORS, Lars, Gunnar; Linsgatan 11, S-554 48 Jönköping (SE).  <b>(74) Agent:</b> LUNDQUIST, Arne; Pionjärgatan 31, S-587 34 Linköping (SE).		<b>(81) Designated States:</b> European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>

**(54) Title:** A METHOD AND A DEVICE FOR OPTICAL MONITORING OF AT LEAST ONE SERIES OF STRINGS, ESPECIALLY FROM GLUE

**(57) Abstract**

A method and a device for optical monitoring of at least one string, especially glue string (2, 3), continuously transported on an underlayer (1) in a first plane in one first direction (4), substantially coinciding with the longitudinal direction of the glue string, is disclosed. The device comprises a light source (5, 6) for directing light towards the glue's string and a camera (7) with a detector (8) in the focal plane in the form of a CCD line array, for continuous imaging of one part of the glue string. The camera is provided to emit one corresponding digital video signal, which is fed to a signal processing unit (9). The light source is provided to direct light substantially perpendicularly,  $\alpha^\circ$ , towards said first direction (4), in an angle  $\beta^\circ$  between  $0^\circ$  and  $90^\circ$  relative to said first plane (1), the camera being directed substantially perpendicularly straight above the glue string, with the CCD-line array substantially at right angle relative to the first direction. The device is characterized primarily in that the signal processing unit (9) is provided to store in a first memory, one video signal coming from the camera (7), continuously intermittently forming a gradient, combined with information, coming from a position determining means (8, 10, 11) about the position of a glue string (2, 3), to a first table as a reference, and that the signal processing unit (9) is provided to store, correspondingly, in at least one second memory, video signal and position for at least one individual glue string so that there is obtained for this an individual table, the signal processing unit (9) being provided to continuously compare the second table with the first table, and at a difference, above a certain, previously determined level, give an indicating signal.



**A method and a device for optical monitoring of at least one series of strings, especially from glue.**

The present invention relates to a method and a device for optical monitoring of at least one line series of strings, especially from glue, of limited length, continuously transported on a underlayer in a first plane, in one first direction, substantially coinciding with the longitudinal direction of the glue strings, the glue strings being illuminated and part of every glue string being intermittently imaged at the detector plane of a camera, a corresponding digital vide signal being sent to a signal processing unit, the light source directing its light in a direction substantially perpendicular,  $\alpha^\circ$ , relative to said first direction, in an angle  $\beta^\circ$  within the range  $0^\circ$  and  $90^\circ$  relative to said first plane, the camera being directed substantially straight from above towards the glue string, so that the line array is located substantially perpendicularly relative to the first direction. The invention also relates to a corresponding device.

Within modern manufacturing technique with very high path rates, e.g. when manufacturing cardboard boxes there are severe problems as to monitoring, in order to obtain correct products. A certain glue feed system sprays a glue string on cardboard flaps in a machine before the automatic folding. The technique to set the glue system means, that the cardboard flaps are firstly transported at a low speed, whereupon this is increased to full speed, which means c:a 5m/sec. The position of the glue string is easily changed at the variation of the speed and the relations between different process parametres are so complicated, that it is very difficult to avoid large cassation due to wrong position of the glue string.

Until now it has been tried to perform automatic control of the position of the glue string by capacitance measurement. The drawback with this method is, that can only indicate the presence of glue, and the measurement is disturbed, if the moisture content in the cardboard path is high. For this reason the control is simply performed by picking out cardboard boxes at random, then tearing them apart for inspection, which means destructive testing, and after adjustment of the glue system a new test is performed.

The object of the present invention is to provide a method and a corresponding device of the art mentioned by way of introduction, that admits safe control but is yet relatively simple to perform resp of a simple design.

According to the invention such a method is characterized primarily in that in a first process step at least one single glue string of desired appearance is imaged continuously

intermittently, forming a gradient from the video signal obtained, whereby the light values so obtained, combined with position values for the glue string, give a first table as a reference, defining the contour of the glue string, stored in a first memory, whereupon in subsequent process steps the glue strings of the line series are imaged correspondingly and are stored in at least one second memory so that there is obtained for each of them an individual table, which is compared with the first table, whereas at a difference above a certain, previously determined level, an indicating signal is emitted.

It is suitable, that the position values for the glue string are obtained by measuring the time, that elapses from the moment, when a reference object like the edge of the cardboard flap passes a photo cell or the like, to the moment, when the front part of the glue string is imaged by the camera. In this way the transportation speed of the glue string may be calculated.

As the exposure frequency normally is fixed, and the capacity of the second memory must be limited for cost reasons, it is suitable, that the frequency for storing position values in the second memory is determined automatically according to the speed of the glue string and the storage capacity of the second memory.

An example of a device according to the invention is disclosed more in detail in the following, reference being made to the enclosed schematical figures, of which figure 1 shows a vertical view in said first direction, that is to say the transportation direction of the glue string, whilst figure 2 shows a plane view of the same device, in part.

In the figures an underlayer in the form of cardboard is denoted by 1, and two glue strings thereupon by 2 and 3. The longitudinal direction of the glue strings coincides with the first direction 4, the transportation direction. A source of light 5, placed in a paraboloid reflector 6 directs light beams in an angle  $\alpha = 90^\circ$  towards the first direction 4 and in an angle  $\beta^\circ$ , in the example shown c:a  $30^\circ$  towards the plane of the cardboard 1. In addition to the parallel light beams there are some light beams with an other direction. This angle shall be within the range  $0^\circ$  and  $90^\circ$  in order to obtain the necessary reflexes from the glue strings, separating these optically from the underlayer, that is to say the cardboard 1. In figure 2 the desired direction of the light cone is marked by 12. A camera 7 is directed straight down towards the plane of the cardboard. The camera comprises a CCD line array 8 directed  $90^\circ$  relative to the first direction 4. From the camera there are emitted continuously intermittent video signals corresponding to images of the glue strings to a signal processing unit 9. A light source 10 directs a light beam perpendicularly to the first direction 4, at a distance before the imaging line of the CCD-

line array, towards a photo cell 11, which is provided to send a signal to the signal processing unit 9.

The device operates by imaging, in a first process step, two glue strings of desired appearance and location at the underlayer, continuously intermittently forming a gradient from the video signal emitted by the camera, in the signal process unit. The light values so obtained are combined with position values for the glue string, that are calculated from the transportation speed, that is obtained by the aid of a signal from the photo cell 11, when the edge of a cardboard flap passes the same and the signal from the camera, when the front of the glue string reaches the sight line of the CCD line array. In this way there is obtained a first table as a reference, which is stored in a first memory in the signal processing unit, defining the contours of the two glue strings. Then the manufacture of the cardboard boxes is started, and the light values of the glue strings and the corresponding position coordinates are stored continuously for corresponding tables in a second memory, and for each pair of glue strings the values of this second table are compared with said first table. At a difference, exceeding a predetermined value, an indicating signal is given from the signal processing unit.

If the transportation speed would be so low, that the capacity of the the second memory would not be enough for the relatively large number of exposures, that would follow each glue string, at the exposure frequency chosen, the signal processing unit is provided, according to the measured transportation speed, only to store part of the exposures made, in the second memory.

By the aid of the method disclosed, and a corresponding device, the form and location of the glue strings at the underlayer, are monitored efficiently.

**Patent claims**

1. A method and a device for optical monitoring of at least one line series of strings, especially from glue, of limited length, continuously transported on a underlayer in a first plane, in one first direction, substantially coinciding with the longitudinal direction of the glue strings, the glue strings being illuminated and part of every glue string being intermittently imaged at the detector plane of a camera, a corresponding digital video signal being sent to a signal processing unit, the light source directing its light in a direction substantially perpendicular,  $\alpha^\circ$ , relative to said first direction, in an angle  $\beta^\circ$  within the range  $0^\circ$  and  $90^\circ$  relative to said first plane, the camera being directed substantially straight from above towards the glue string, so that the line array is located substantially perpendicularly relative to the first direction.  
characterized in  
that in a first process step at least one single glue string of desired appearance is imaged continuously intermittently, forming a gradient from the video signal obtained, whereby the light values so obtained, combined with position values for the glue string, give a first table as a reference, defining the contour of the glue string, stored in a first memory, whereupon in subsequent process steps the glue strings of the line series are imaged correspondingly and are stored in at least one second memory so that there is obtained for each of them an individual table, which is compared with the first table, whereas at a difference above a certain, previously determined level, an indicating signal is emitted.
2. A method according to claim 1,  
characterized in  
that the position values for the glue string are obtained by measuring the time, that elapses from the moment, when a reference object passes a photo cell or the like, to the moment, when the front part of the glue string is imaged by the camera.
3. A method according to claim 2,  
characterized in  
that the frequency for storing position values in the second memory is determined automatically according to the speed of the glue string and the storage capacity of the second memory.
4. A device for optical monitoring of at least one glue string (2,3), continuously transported on an underlayer (1) in a first plane in one first direction (4), substantially coinciding with the longitudinal direction of the glue string,  
comprising  
a source of light (5,6) for directing of light towards the glue string, and

a camera (7) with a detector (8) in the focal plane in the form of a CCD line array, for continuous imaging of one part of the glue string, the camera being provided to emit one corresponding digital video signal, which is fed to a signal processing unit (9), the light source being provided to direct light substantially perpendicularly,  $\alpha^\circ$ , towards said first direction (4), in an angle  $\beta^\circ$  between  $0^\circ$  and  $90^\circ$  relative to said first plane (1), the camera being directed substantially perpendicularly straight above the glue string, with the CCD-line array substantially at right angle relative to the first direction, characterized in

that the signal processing unit (9) is provided to store in a first memory, one video signal coming from the camera (7), continuously intermittently forming a gradient, combined with information, coming from a position determining means (8,10,11) about the position of a glue string (2,3), to a first table as a reference, and that the signal processing unit (9) is provided to store, correspondingly, in at least one second memory, video signal and position for at least one individual glue string so that there is obtained for this an individual table, the signal processing unit (9) being provided to continuously compare the second table with the first table, and at a difference, above a certain, previously determined level, give an indicating signal.

5. A device according to claim 4, characterized in

that the position determining means comprises a photo cell (11), located before the sight line of the detector (8).

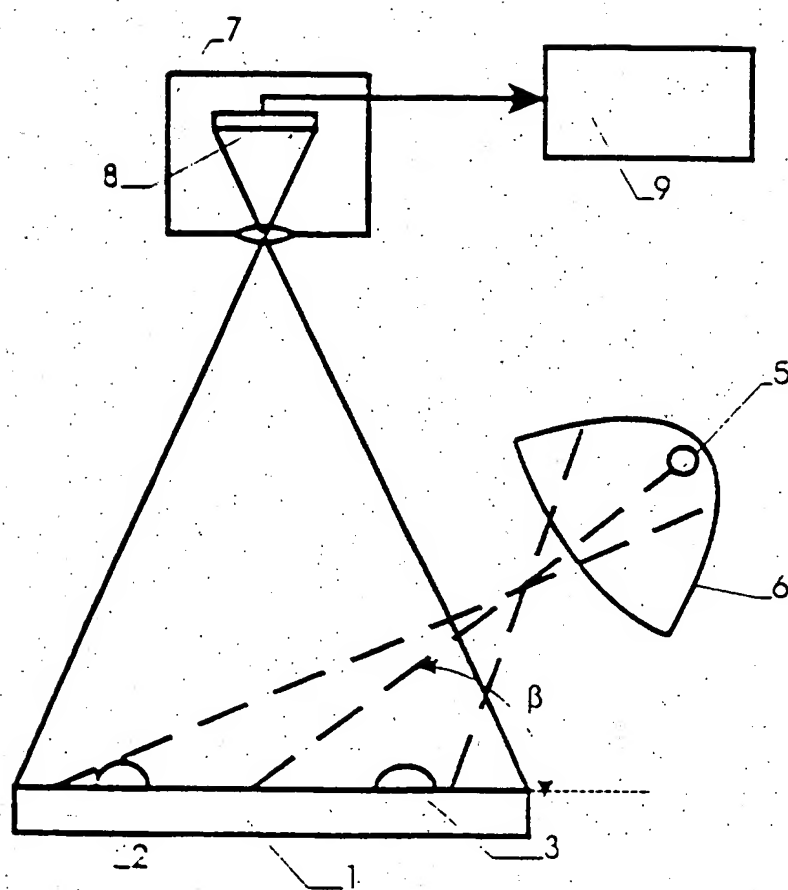


FIG 1



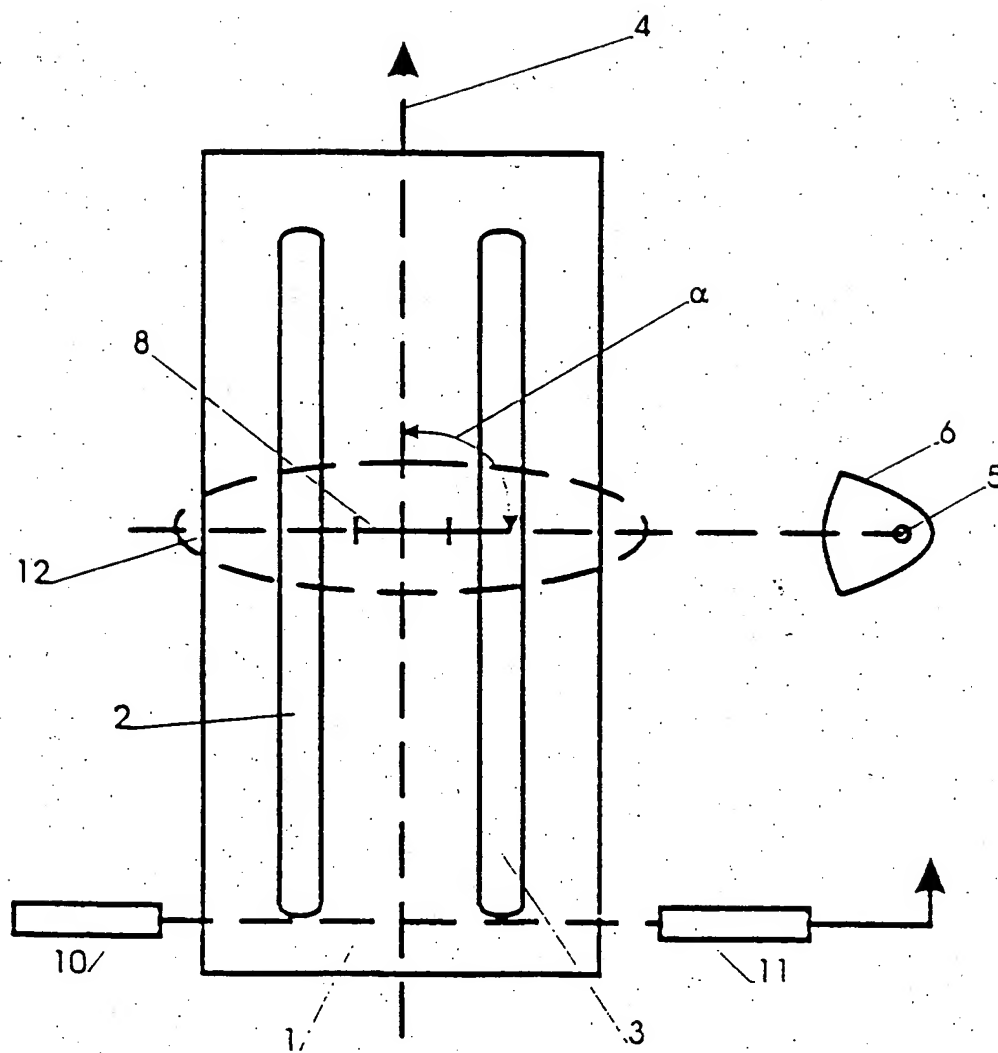


FIG 2

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
**PCT/SE 96/00534**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP-A1- 0369585	23/05/90	DE-D,T- 68908851	16/12/93
		DE-D,T- 68922957	19/10/95
		EP-A,A,B 0366235	02/05/90
		JP-A- 2121577	09/05/90
		JP-A- 2141647	31/05/90
		US-A- 4922337	01/05/90
		US-A- 4949172	14/08/90
DE-C2- 3816392	19/03/92	AU-B,B- 624136	04/06/92
		AU-A- 3407089	16/11/89
		CA-A- 1312377	05/01/93
		DE-D,T- 68919120	18/05/95
		EP-A,A,A 0342127	15/11/89
		ES-T- 2066005	01/03/95
		FI-B- 96546	29/03/96
		JP-A- 2073140	13/03/90
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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 96/00534

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01N 21/89

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, WPAT, USPM

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0369585 A1 (PICKER INTERNATIONAL, INC.), 23 May 1990 (23.05.90), column 5, line 44 - line 55; column 6, line 3 - line 14 --	1-5
A	DE 3816392 C2 (VEGLA VEREINIGTE GLASWERKE GMBH), 19 March 1992 (19.03.92), column 2, line 51 - column 3, line 21, figure 1 -----	1-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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